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Neuroenhancement

Alexandre Erler and Cynthia Forlini
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1) Article summary

Neuroenhancement is generally defined as the improvement of mental capacities. Such an improvement can be effected via traditional (e.g. education) or biomedical means. The use of the latter, in particular, is fiercely debated in various contexts. This entry focuses on neuroenhancement by means of biomedical technology, and on its use by competent adults in a non-military context, for non-therapeutic purposes.

There are two main categories of neuroenhancement: cognitive and affective. Cognitive enhancement includes the use of psychoactive drugs like methylphenidate and modafinil to enhance wakefulness and concentration. Other capacities targeted for neuroenhancement include memory and learning, although there is still controversy about the impact of such substances on real-life (e.g. academic) performance. More recent and sophisticated neuroenhancement interventions include interventions such as electrical brain stimulation, and more speculative ones like brain implants. Affective enhancement comprises the modification of personality in socially rewarded ways, the improvement of mood, the removal or blunting unpleasant memories, the enhancement of motivation, and the modulation of romantic bonds between people.

Prevalence estimates of neuroenhancement are highly variable according to technology, population, and environment, but provide a springboard for thinking about why individuals choose to engage in neuroenhancement. First, there is limited evidence to support safety and efficacy of existing neuroenhancement technologies. Chronic use of psychostimulants, for instance, can present health risks and lead to tolerance. Studies show that even if neuroenhancement technologies were efficacious, there can be limitations to their effects (due for instance to cognitive trade-offs). Second, neuroenhancement raises pressing ethical issues. The issue of fairness looms large in the ethical debate raising the question of what forms of improvement constitute “cheating”, as well as highlighting the need to ensure equitable access to any competitive advantages that neuroenhancement might confer. Several

different concerns about neuroenhancement fall under the umbrella of "authenticity", which pertain to now neuroenhancement affects one's identity, sense of self, true nature, and sense of achievement. Finally, there is disagreement as to whether the availability of neuroenhancement promotes personal autonomy or contributes to the rise of coercion to enhance.

2) Defining neuroenhancement

In a general sense, neuroenhancement designates a set of methods that can improve people's mental capacities. The phrase is also used to refer to the process of improvement itself, or to its outcome. There are, however, two dimensions along which philosophical definitions of neuroenhancement can be broader or narrower in nature. The first such dimension relates to the type of improvement *method* being considered. On a broad understanding, neuroenhancement includes non-biomedical means like education, mental training (e.g. mnemonic techniques or meditation), caffeine, and even physical exercise, as well as biomedical interventions. On a narrower conception, one that makes neuroenhancement ethically more controversial, the phrase exclusively covers biomedical forms of improvement (see "Technology and Ethics", by Carl Mitcham and Helen Nissenbaum, in the REP), from drugs to brain stimulation, as laid out in more detail in the next section.

The second dimension underlying broader and narrower definitions of neuroenhancement has to do with the *initial state* of the mental capacities being targeted, which could either involve a mental pathology, or a healthy state. The so-called treatment-enhancement distinction is relevant here (Erler, 2017). Leaving aside the tricky question of whether we can reliably and meaningfully distinguish between "normal" and "pathological" states, a broad definition of neuroenhancement encompasses both therapeutic and non-therapeutic forms of improvement (e.g. Dresler et al., 2019). A narrower definition reserves the 'neuroenhancement' label for interventions of the latter type, even though the tools they involve can in principle be used for therapeutic purposes. This entry will explore the myriad ethical controversies specific to the narrow definitions of neuroenhancement.

The narrow definition of neuroenhancement has inspired diverse nomenclature in the academic literature and public sphere. Some terms refer to the therapeutic foundations of neuroenhancement by discussing "non-medical" uses of substances and devices or even "cosmetic neurology" (Chatterjee, 2006). Others reflect a lifestyle choice related to general wellbeing such as "better living through chemistry". Our use of the word "neuroenhancement" focuses on functional outcomes in an attempt to avoid the kind of built-in ethical judgments that other definitions arguably introduce, such as the "welfarist" definition of enhancement as including any intervention that increases a person's chance of living a good life in a given set of circumstances (Savulescu et al., 2011).

One might question whether neuroenhancement must necessarily involve an *improvement* in mental capacities, suggesting instead that *diminutions* in such capacities can sometimes also deserve the label. Possible examples include technologically erasing painful, although non-pathological memories to enhance mood, or reducing the propensity to aggression in someone with a criminal history, but no diagnosed mental disorder, to enhance moral disposition. While such cases might indeed reasonably be construed as neuroenhancement, we may note that the ultimate goal and outcome of the relevant diminution is still to improve some other aspect of mental functioning.

This entry focuses on the (non-therapeutic) use of neuroenhancement interventions by competent adults. In order to focus the scope of our discussion, we mostly leave aside issues such as the application of neuroenhancement to children and the prenatal use of genetic interventions to maximize the mental abilities of future individuals (see “Genetic modification”, by Ainsley Newson and Antony Wrigley, and “Genetics and Ethics”, by Ruth Chadwick, in the REP). Furthermore, while acknowledging the importance and extensive history of military uses of enhancement technologies, we limit our overview of the ethics to the *civilian* context. A thorough discussion of the ethics of military neuroenhancement would require a separate entry.

3) The different types of neuroenhancement

A variety of mental capacities are candidate targets for neuroenhancement. This section provides a brief overview of the capacities in question, and of the interventions, both existing and prospective, that might be used to improve them. For classificatory purposes, we can broadly distinguish two main categories of interventions: those targeted at “cognitive enhancement”, and those aimed at “affective enhancement”.

a) Cognitive enhancement

The most familiar example of cognitive neuroenhancement is probably the use of psychoactive drugs (dubbed “smart drugs” in the media) by healthy students with the goal of improving academic performance. Such drugs, originally designed to treat pathological conditions like ADHD, include stimulants like amphetamine and methylphenidate, and more recently, the wakefulness-promoting agent modafinil (Dubljevic, 2016; Brühl et al., 2019). Besides the student context, such drugs also have an established history of use in the armed forces among military pilots (Mehlman, 2015). These substances are typically used to enhance wakefulness and concentration when working for extended periods (as in the case of an all-night study session, or a prolonged air combat mission) – although, as we will see later on, the drugs might be achieving their putative enhancement effects by impacting affective, rather than just cognitive, factors.

Besides seeking means of focusing better and for longer on cognitively demanding tasks, a number of people turn to pharmacology with the aim of boosting their memory and their ability to learn. Some evidence has been found of positive effects of the above-cited drugs, as well the acetylcholinesterase inhibitor donepezil (Aricept), on certain aspects of memory and learning (Bagot and Kaminer, 2014; De Jongh, 2017). Whether such effects do in turn tend to improve academic performance among student users is questioned (Arria et al., 2017).

Beyond psychoactive drugs, a more recent trend has been the growing interest in the cognitive enhancement potential of various forms of brain stimulation. These include, in particular, non-invasive forms such as transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS). TMS involves the placing of an electromagnetic coil over the brain region to be stimulated, delivering short, high-power electrical surges. It requires relatively expensive and cumbersome equipment, making it fundamentally an in-clinic intervention. tDCS, by contrast, applies a low current to the brain via electrodes. tDCS devices are more portable and affordable than TMS equipment, making the technology more readily available for enhancement use outside the clinical context, as illustrated by the emergence of a "do-it-yourself" tDCS community (Wexler, 2016) and of commercial tDCS devices for home use.

In addition to its potential for the treatment of conditions such Alzheimer's disease and anxiety disorders, TMS has been reported to improve performance on attention, memory, and language tasks among healthy subjects (Luber and Lisanby, 2014). Similarly, tDCS is regarded as holding promise as a therapeutic option for patients with major depressive disorder, but may also be able to enhance attention, learning and memory in the non-impaired (Coffman et al., 2014), as well as vigilance in conditions of sleep deprivation (McIntire et al., 2014). A study conducted by U.S. military scientists reported that tDCS could help enhance multitasking skills (Nelson et al., 2016).

Finally, brain-computer interfaces (BCIs) represent a more futuristic and radical avenue towards the enhancement of memory and other aspects of cognitive functioning (Dresler et al., 2019). Such devices can be more or less invasive, some requiring implantation under the scalp ("neural implants"), which carries greater risk but also tends to provide the most accurate reading of brain signals, while others use different methods, such as non-invasive neuroimaging. Most human applications of BCIs so far have been therapeutic in nature (e.g. allowing tetraplegic patients to control robotic limbs directly with their thoughts), yet some entrepreneurs working on the technology have explicitly stated their intention of ultimately achieving neuroenhancement applications (Jee, 2019). Recent research on memory implants has already suggested some enhancement potential in humans (Hampson et al., 2018).

b) Affective enhancement

Affective enhancement is arguably as old as the discovery of mood-altering substances, including hallucinogenic plants and alcohol, thousands of years ago. Discussions of the prospect of manipulating "normal" human feelings using biomedical means have a briefer, yet still long history: think for instance of the drug soma in Aldous Huxley's novel *Brave New World* (Huxley, 1932). Public interest in such discussions was stimulated in the 1990s via psychiatrist Peter Kramer's book *Listening to Prozac* (Kramer, 1993). In it, Kramer describes patients whom he treated with the antidepressant fluoxetine (Prozac) for various mental ailments including depression, and who, according to him, were not merely cured but transformed, becoming "better than well". Some reportedly developed a consistently high mood and a much more assertive (and socially rewarded) personality. Kramer's stories remain anecdotal, and it is unclear at this point that one could reliably generate the type of personality makeover he describes using any psychoactive drug. Nonetheless, meta-analyses of the effects of "SSRI" antidepressants like fluoxetine on healthy subjects do suggest a decrease in negative affect (Serretti et al., 2010).

One might seek to improve mood directly by taking antidepressants (or more traditionally, by consuming alcohol, or exercising). Indirect methods are also possible by erasing painful memories, or retaining their informational content but blunting their emotional impact – a process termed "memory editing" (Erler, 2011). Alleviating the symptoms of conditions like posttraumatic stress disorder is possible with some psychological interventions in a therapeutic context. Studies are now investigating whether better results can be achieved using biomedical means. One major example is the use of the beta-blocker propranolol, which can blunt a traumatic memory by disrupting either the original consolidation process (if used before or shortly after the event that caused it) or its "reconsolidation", if used when the memory is brought back to mind at a later time (Beckers and Kindt, 2017). Other interventions being considered include optogenetics, a technique that uses lasers to alter memories by directly targeting certain neurons previously made sensitive to light (Glannon, 2019). The use of such tools to edit unpleasant but non-pathological memories, however, remains speculative.

Besides lifting mood and changing personality in desired ways, affective neuroenhancement might also target motivation, and emotional and behavioural dispositions. Some users of "smart drugs" thus report that the productivity benefits they claim to derive from them are at least partly related to the drugs' positive impact on their motivation and energy levels (Ilieva and Farah, 2013). Besides the quest for greater productivity, however, the manipulation of motivation might also be tied to a different goal, that of *moral* neuroenhancement, which describes the improvement of a person's moral capacities, motives, and behaviour. Some have suggested that drugs like modafinil and methylphenidate could, if coupled with good moral education, help enhance moral reasoning and overcome weakness of the will (Earp et al., 2017). They also propose the potential of the hormone oxytocin to help increase pro-social emotions like empathy. SSRIs or brain stimulation have been discussed as candidates for reducing anti-social dispositions like aggression (Focquaert and Schermer, 2015).

One last subset of affective neuroenhancement concerns the prospect of using biomedical means to strengthen romantic bonds between two people over time, or on the contrary, to prevent the formation of such bonds when it is judged undesirable. Discussions of this issue, like the debate on moral neuroenhancement, mostly focus on the desirability of developing future interventions for such purposes, rather than on existing practices (as in the case of the controversy around smart drugs). Proponents of "love drugs" cite substances like oxytocin and MDMA as potential means of reinforcing pair bonding (Savulescu and Sandberg, 2008). By contrast, they mention SSRIs, androgen blockers, and the lowering of oxytocin levels as candidates forms of "anti-love biotechnology" (Earp et al., 2013).

4) Estimated prevalence of neuroenhancement technology use

The exact prevalence of neuroenhancement practices in the general population is an elusive figure. Referring to Dresler et al.'s (2019) model of cognitive enhancement interventions, neuroenhancement broadly understood appears ubiquitous given behavioural interventions such as sleep, exercise, and nutrition used to enhance focus and concentration. However, in line with the focus of this entry, formal studies on the prevalence of neuroenhancement predominantly address the use of novel and repurposed technology that is accessible to the public such as stimulants and wearable brain stimulation. BCIs are less the subject of curiosity with respect to prevalence because they require medical oversight to implant and monitor.

Prevalence estimates of neuroenhancement are highly variable according to technology, population, geography, and cultural context. Varying study methodology, data analysis, definitions of neuroenhancement and measures of lifetime or past-year use can reduce the comparative value of data. It is thus impossible to provide a globally relevant statistic. Most of the existing prevalence data focuses on the use of stimulants by university students because the higher education setting is considered a risk factor for increased diversion and use of prescription stimulants for neuroenhancement (Ford and Pomykacz, 2016). The abundance of research on the prevalence of neuroenhancement hailing from North America has established this region as a benchmark for comparison, further fuelled by media coverage describing neuroenhancement as an American 'trend' (Forlini and Racine, 2009). A review of North American studies on the non-medical use of stimulants in students reported a prevalence range of 2.5%- 55% (Smith and Farah, 2011). International data on the use of prescription and illegal stimulants for neuroenhancement has proven equally diverse with rates of 2.2% in Germany (Forlini et al., 2015), 11% in Austria (Dietz et al., 2018), 16% in Italy (Castaldi et al., 2012), 17 % in Switzerland (Maier et al., 2013), 7.8% in the Netherlands

(Schelle et al., 2015), 10% in the United Kingdom and Ireland (Singh et al., 2014), 11% in South Africa (Jain et al., 2017), and 6.5% in Australia (Lucke et al., 2018). A few studies have approached the subject of neuroenhancement in professional practice. Franke et al. (2013) reported that 8.9% of their sample of German surgeons had used a prescription or illegal stimulant in their lifetime for neuroenhancement. Dietz et al. (2016) reported that 19% of a sample of professionals working in the field of economics had done the same. Whether available neuroenhancement prevalence data are indicative of an underlying issue is a matter of contention that has evoked discussions of self-medication (Lucke et al., 2013), professional responsibility of medical professionals with respect to prescribing substances (Forlini et al., 2013), and institutional policies on neuroenhancement (Aikins et al., 2017).

There have been a few attempts to study neuroenhancement in the general population. In 2008, the science journal *Nature* published the results of a public poll stating that 20% of the 1400 respondents from 60 countries had used a prescription pharmaceutical for enhancement purposes (Maher, 2008). Partridge et al. (2012) found a 2.4% prevalence of stimulant use for neuroenhancement in an Australian community sample in 2012. Two small studies have brought to light the active community of at-home tDCS users in the general public. Wexler's study showed that the typical tDCS user was "a wealthy, highly educated, liberal, fortysomething male living in the USA who reported being an early adopter of technology" with three quarters of respondents using the technology for neuroenhancement (Wexler, 2018, p. 131). Jwa (2015) confirmed that tDCS was being used at home mostly for neuroenhancement but also self-treatment of several types of neurological conditions. Most recently, Maier et al. (2018) published a cross-sectional study of results from the Global Drug Survey (GDS), an anonymous web survey on substance use conducted annually in 15 countries with participants aged 16-65. The study found a 180% increase in the use of prescription and illegal stimulants for neuroenhancement between the GDS in 2015 (4.9%) and the GDS in 2017 (13.7%). Evidence of increased prevalence in all countries participating in the GDS challenges critiques of prevalence data that is used to sustain the 'myth' that neuroenhancement is widespread and increasing (Schleim and Quednow, 2018; Zohny, 2015).

5) Ethical issues pertaining to neuroenhancement

a) Limited evidence to support the safety and efficacy of neuroenhancement technologies

Given that some putative neuroenhancement technologies have medical indications (as discussed above) or research uses (e.g. tDCS for stroke rehabilitation), safety and efficacy in healthy individuals is often (erroneously) assumed by those seeking neuroenhancement (Forlini and Racine, 2012b). Excessive or chronic use of psychostimulants in the absence of a medical need carries known risks including addiction, psychosis, and even sudden death in some cases (Lakhan and Kirchgessner, 2012). Chronic neuroenhancement use may itself lead to excessive use if it fosters tolerance to the drug in question. While modafinil and tDCS seem to display a favourable safety profile even when used for neuroenhancement purposes, the long-term effects of such use are still not fully known (Brühl et al., 2019). Furthermore, the use of tDCS by hobbyists outside the clinical context may present additional risks, related for instance to incorrect placement of the electrodes (Jwa, 2015).

From a scientific perspective, there is no consensus on whether repurposed or investigational technologies produce significant and consistent neuroenhancement effects in healthy individuals (Dresler et al., 2019). There is weak evidence demonstrating neuroenhancement effects of substances such as methylphenidate (Repantis et al., 2010b), antidepressants (Repantis et al., 2009) and donepezil (Repantis et al., 2010a). Systematic reviews report moderate efficacy of modafinil for neuroenhancement, which is emerging as a popular option because most experience few or no side effects (Battleday and Brem, 2015). Outside the laboratory, students using prescription medication for neuroenhancement did not experience improvement in their grades over four years of study (Arria et al., 2017). In fact, students showing the greatest improvement were those that abstained from using prescription medications. Given the inconsistent evidence base on the efficacy of purported neuroenhancement substances, it is unclear whether individuals can make truly informed decisions. Indeed, individuals may be encouraged to use these substances by secondary sources such as the media or social media networks (Forlini et al., 2015). These sources are known for relating anecdotal evidence about neuroenhancement effects without equal discussion of the risks or medical oversight that would typically be available to individuals with a prescription for medications associated with neuroenhancement.

Though they appear promising, data on the neuroenhancement effects of non-invasive brain stimulation devices is inconsistent due to lack of comparable and successfully replicated studies (Reteig et al., 2017). Furthermore, it is unclear to what extent commercially available brain stimulation devices are based on validated laboratory research (Wexler and Reiner, 2019). In this regard, neuroenhancement raises ethical concerns because individuals without any impairment could be incurring undue risk using substances and devices outside of sanctioned indications in the absence of oversight, medical or otherwise. These concerns have led to calls for a public health framework for neuroenhancement that recognizes the positive effects of healthy behaviours such as proper sleep, exercise and nutrition in order to discourage the use of unproven and potentially deceptive technologies (Lucke and Partridge, 2013).

Studies show that even if neuroenhancement technologies were efficacious, there might be limitations to their effects. First, the amount of enhancement experienced could be dependent on dose and subject. Reviews of the effects of prescription stimulants indicate an inverted U-shaped dose-response model where low doses improve cognitive performance but high doses impair performance (de Jongh et al., 2008). Similarly, the neuroenhancement effects of prescription stimulants, brain stimulation, and cognitive training appear to be dependent on an individual's baseline performance (Dresler et al., 2019). The higher the baseline performance, the smaller the enhancement effect. These findings are interpreted as an "enhancement ceiling" indicating that perhaps human cognition has a definitive performance upper limit (Farah et al., 2009). Second, cognitive "trade-offs" have been observed in neuroenhancement uses of pharmaceuticals and brain stimulation. These occur when one cognitive capacity is enhanced at the detriment of another suggesting that cognition has a maximum capacity often likened to a zero-sum game (de Jongh et al., 2008; Brem et al., 2014). None of these limitations seems to have hampered the enthusiasm for neuroenhancement, which some argue may be fuelled by anecdotal evidence or a placebo effect (Smith and Farah, 2011).

The uncertainty in scientific evidence on the safety and efficacy of neuroenhancement for healthy individuals is difficult to reconcile with its prevalence. Even the lowest prevalence rates indicate a group of individuals prepared to incur disappointment or risk to their health in pursuit of enhanced cognition. The contexts that motivate the pursuit of enhanced cognition are discussed in the remainder of this section. These contexts reinforce the need for ethical deliberation to guide acceptability of these practices (Forlini and Racine, 2013). Insofar as the enhancement effect of some existing interventions is still an open question, and as the advent of more clear-cut instances of neuroenhancement remains a future possibility (actively pursued by some), discussions that assume the efficacy of such interventions need not be reduced to idle speculation. Nonetheless, contributors to such discussions should be careful to make their empirical assumptions explicit, and to indicate the extent to which they are supported by the available evidence (Racine et al., 2014).

b) Fairness as a multi-faceted concept in neuroenhancement

The zero-sum model has guided debates about the fairness of neuroenhancement. The assumption is that one individual's cognitive gain is another's loss. It has inspired polarized positions about whether neuroenhancement constitutes cheating in competitive environments (Schermer, 2008). While that question remains unresolved, there are indications that an answer hinges on the authenticity of a performance, i.e. whether neuroenhancement provides a replacement or shortcut in the effort required to achieve a performance or goal (Forlini and Racine, 2012a). This view invites analogies of neuroenhancement with sports competitions that have strict rules against certain types of performance enhancement (Savulescu, 2006). What rules would neuroenhancement break? Someone who won the World Memory Championships by using a futuristic BCI that allowed storage and retrieval of information with the ease of a computer would obviously be in breach of Championship rules, but it is unclear what rules would be broken by neuroenhancement in other competitive academic or professional environments. Neuroenhancement technologies may have an effect on the concentration, alertness and memory of healthy individuals but they are not the type of fictionalized "smart drug" that confers intelligence, instant learning, or recall. The argument here is that neuroenhancement is not considered cheating because it does not replace the intellectual work done in academic or professional environments (Forlini and Racine, 2012a). In fact, students appear more accepting of neuroenhancement than plagiarism, which is universally considered an infringement of academic integrity (Palamenghi and Bonfiglioli, 2019). There is regulation regarding the sale and consumption of prescription substances and illicit substances that are associated with neuroenhancement effects. However, Duke University (USA) is the only academic institution that has a policy about "academic doping" (Aikins et al., 2017). With incomplete information about how current neuroenhancement technologies affect cognition, it is difficult to enforce policies about neuroenhancement.

Access is another facet of fairness relevant to neuroenhancement. Here, it is important to include both access to neuroenhancement technology and access to opportunity. There is evidence from prevalence studies that use of prescription stimulants varies according to university location, academic performance, fraternity membership, and history of drugs use. Wealth is also reported as a characteristic of early adopters of tDCS (Wexler, 2018). All of these factors can have socio-economic underpinnings, which would enable or restrict access to neuroenhancement technology (Bogle and Smith, 2009). Access to neuroenhancement based on affluence would be unfair because it causes or reinforces disadvantage. However, some have argued that this is not a compelling argument against human enhancement generally because so much inequality is already present and tolerated in the form of a "natural lottery" of capabilities and disabilities (Savulescu, 2006; Harris, 2007). Furthermore, neuroenhancement could actually be used to promote equality in society as "opportunity maintenance" which Ray (2016) describes as "a means of remedying underprivileged children's experiences of social inequalities that are borne from inadequate schools" (p. 29). There is significant empirical evidence of public support for the use of neuroenhancement to "enhance to the norm" (Cabrera et al., 2014), "normalize" or "restore" cognitive function (Sabini and Monterosso, 2005). Again, the desired opportunities or level of cognitive function the stakeholders in question seek is still a matter of debate.

c) Neuroenhancement raises concerns about authenticity

Several different concerns about neuroenhancement can be brought under the umbrella of "authenticity". One states that someone who technologically enhances her mental abilities (especially to a significant degree) will no longer be "the same person" as before. This concern is also sometimes formulated in terms of a supposed threat to the person's "identity" (Elliott, 1999). Second, neuroenhancement, particularly of mood and emotions, risks making people feel better at the cost of disconnecting them from the true nature of their alienating circumstances, acting as Marx's proverbial "opium of the people" (Elliott, 1998). A third concern coincides with the worries about fairness described above, suggesting that neuroenhanced outcomes are somehow "fake" and tantamount to "cheating" (Schermer, 2008). Part of the broader definition of neuroenhancement, use of caffeine and personal tutors are typically exempt from this concern.

As David DeGrazia has pointed out, concerns about the impact of neuroenhancement on "identity" are often ambiguous between two different senses of the term: numerical identity, which concerns the grounds of our persistence through time as discrete individuals, and "narrative" identity, which refers to the set of attributes that make us the particular individuals we are (DeGrazia, 2005). While threats to numerical identity are undoubtedly a serious matter (being equivalent to the destruction of an individual!), neuroenhancement-induced alterations of narrative identity are both more likely and less obviously problematic.

The philosophical debate on neuroenhancement and identity is ongoing. Though neuroenhancements are typically intended to produce positive effects, one might contend that improving some aspect of mental functioning can have a negative impact overall on narrative identity. For example, increasing happiness by boosting the disposition to positive affect and reducing that to negative affect might render someone less empathetic towards others. Or, it might make her less attuned to the dark reality of her condition (a line of argument that would bring together the first two authenticity-related concerns). Alternatively, the issue might concern the transformative intervention itself rather than its outcome: it might be said to manifest problematic attitudes, such as self-objectification.

In response, we may note that while such concerns do seem applicable in *some* cases of neuroenhancement, it is debatable whether they apply to *all* neuroenhancement use – even when it affects narrative identity. After all, insofar as the capacity for empathy, or the ability to realistically assess one's own circumstances, ultimately depend (like all mental capacities) on the way our brain functions, we may conclude that they, too, could in principle be *improved* via neuroenhancement. In that case, the intervention would actually be *enhancing* rather than compromising authenticity as authors like Elliott understand it (Levy, 2011). And this seems true even in cases where no pathological state is involved. Insofar as "normal" mental functioning does not mean always having perfectly rational or "fitting" emotional responses, it is still compatible with both excesses and deficits in traits like empathy or pessimism (Kahane, 2011). We may also question whether *all* cases of neuroenhancement must exhibit problematic attitudes. For instance, it is not clear that using biomedical means to reduce racial bias, or improve one's memory (in someone at the lower end of "normal" memory), would make one open to the charge of self-objectification.

Similar remarks apply to the idea that neuroenhancement can only yield "fake" improvements or achievements. In some cases, the charge will have bite. These include cases where an intervention is unduly perceived as having enhancing effects. They can also include effective interventions, in cases where these do not produce the relevant outcome in the "right" manner. The fictional, BCI-assisted winner of the World Memory Championships described above could be rightly accused of cheating – not just for breaking the rules of the contest, but also for failing to demonstrate the kind of excellences (successful mastery of challenging mnemonic techniques, etc.) that the contest was meant to test. Unlike someone who solicited the services of a ghost writer, a (healthy) student who produced a quality essay while relying on stimulation medication to focus better would not seem guilty of an inauthentic accomplishment, as long as she did not claim to have written the essay without any such help (Kadlac, 2017).

d) To neuroenhance or not to neuroenhance?

The potential for neuroenhancement to enable self-fulfilment or self-creation presents an attractive opportunity but also a pivotal decision. There is significant disagreement about whether individuals ought to have the choice to use neuroenhancement and whether that choice could ever be autonomous. The concept of "cognitive liberty" reflects "every person's fundamental right to think independently, to use the full spectrum of his or her mind, and to have autonomy over his or her brain chemistry" (Sententia, 2004, p. 223). It condones the availability and use of neuroenhancement technologies to support every individual's self-fulfilment. Indeed, some argue that neuroenhancement allows individuals to exercise their autonomy to its fullest potential by improving reasoning abilities (Schaefer et al., 2014). However, some consider that the choice to enhance ought not to exist. This reasoning is attributed to conservative stances that deem neuroenhancement as an affront to 'human nature', and the inalterable cognitive capabilities we are 'gifted' at birth (The President's Council on Bioethics (U.S.), 2003; Sandel, 2007). While there is enthusiasm to study and reap the benefits of neuroenhancement, it is unclear how the choice to use neuroenhancement technology would be presented to individuals.

For the moment, neuroenhancement is largely regarded as a personal choice according to the lifestyle paradigm prevalent in media coverage of the phenomenon (Forlini and Racine, 2009). Empirical studies also support this view emphasizing the importance of autonomy and personal values of individuals when choosing to use neuroenhancement (Goldschmidt and Renn, 2006). However, in reality this decision is complicated by the collision of belief in personal choice with peer or social pressures present in environments that could influence the behaviour of individuals (Schelle et al., 2014). University students have reported feeling at a disadvantage knowing that other students could be performing better with neuroenhancers. It is believed that this feeling creates implicit coercion that increases willingness among students to use neuroenhancement (Sattler et al., 2013). The extent to which such implicit coercion should be viewed as problematic is a matter of dispute (compare Vincent and Jane, 2014, and Erler, 2020). Others have discussed whether explicit coercion by employers might be justified for professions that depend alertness and mental acuity to navigate high-risk situations such as medical professionals, pilots and military personnel (Schoomaker, 2007, Appel, 2008, Sugden et al., 2010). The question is whether their choice to enter a profession or the military justifies coercive measures to use neuroenhancement to maintain a high level of performance (see "Coercion", by Joel Feinberg, in the REP).

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